PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 10/791,927 | Art Unit: 2627

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First Named Inventor: Matthew J. Carey | Date: May 8, 2006

Title: **MAGNETORESISTIVE SENSOR WITH ANTIFERROMAGNETIC EXCHANGE-COUPLED STRUCTURE HAVING UNDERLAYER FOR ENHANCING CHEMICAL-ORDERING IN THE ANTIFERROMAGNETIC LAYER**

RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is in response to the Office communication mailed 04/19/2006.

Claims 1-21 remain. For the reasons stated below none of the claims have been amended.

Independent claims 1 and 9 have been rejected under Section 102(b) over each of US 6,819,532 B2 (Kamijo) and US 5,287,238 (Baumgart). All other claims have been rejected under either Section 102(b) or Section 103(a) over either or both of Kamijo and Baumgart. Applicants believe that neither Kamijo nor Baumgart teaches that for which it is asserted in the Office Action and thus none of Applicants' claims are anticipated or rendered obvious by either Kamijo or Baumgart, alone or in combination.

Applicants will focus on claim 1, but the analysis is also applicable to claim 9. Applicants' invention is an exchange-coupled structure that requires an *underlayer* of a select group of *chemically-ordered alloys with a tetragonal crystalline structure* (AuCu, FePt, FePd, AgTi3, Pt Zn, PdZn, IrV, CoPt and PdCd) and *an antiferromagnetic layer in contact with the underlayer* that is also of a select group of *chemically-ordered alloys with a tetragonal crystalline structure* (PtMn, NiMn, IrMn, PdMn and RhMn). A ferromagnetic layer is exchange-coupled with the antiferromagnetic layer to complete the exchange-coupled structure.

The Kamijo Reference

Kamijo has been cited as a Section 102(b) reference because it shows:

> an "underlayer (figure 2, item 11) formed of a substantially chemically-ordered alloy having a tetragonal crystalline structure, the alloy selected from the group consisting of alloys of AuCu … (column 3, lines 30-31 (these alloys are tetragonal))" and
>
> "an antiferromagnetic layer in contact with the underlayer (figure 2, item 12) and formed of a substantially chemically-ordered alloy comprising X and Mn and having a tetragonal crystalline structure, wherein X is selected from the group consisting of Pt, Ni, Ir, Pd and Rh (column 21, line 67)"…

First, item 11 in Figure 2 of Kamijo is *not* a CuAu ($L1_0$ type) alloy. Item 11 has a foundation layer 11a and *a foundation layer 11b* that is in contact with the antiferromagnetic layer 12. Foundation layer 11b is *"preferably made of NiFe, NiFeB, Cu, and $Co_{90}Fe_{10}$"* (column 14, lines 42-45). The conclusion that item 11 is described in column 3, lines 30-31 is incorrect. That reference describes the well-known background art, namely that the *antiferromagnetic layer* can be a CuAu ($L1_0$ type) alloy. (The term "CuAu type" alloy is a commonly used term to describe the class of $L1_0$ type of materials shown in Fig. 1 and described on page 3, lines 3-13 of Applicants' application). The reference in Kamijo at column 3, lines 30-31 makes it clear (in a complete reading of lines 28-35) that the *antiferromagnetic layer* can be *either* a disordered alloy (like IrMn described later in Kamijo) or a CuAu ($L1_0$ type) alloy like PtMn. Column 3, lines 30-31 of Kamijo have no relevance to the *underlayer* of Applicants' invention.

Second, item 12 in Figure 2 of Kamijo is *not* a "chemically-ordered alloy comprising X and Mn and having a tetragonal crystalline structure". Item 12 is the *disordered* IrMn alloy (column 13, lines 65-67), which has been previously described as one of the known types of antiferromagnetic materials (column 3, lines 28-29) *other* than the known CuAu-type of antiferromagnetic material (column 3, lines 30-34).

Because each and every element in Applicants' claim 1 must be shown in a Section 102(b) reference, and because Kamijo does not show either the claimed *underlayer* or the claimed *antiferromagnetic layer in contact with the underlayer*, Kamijo is not a Section 102(b) reference.

The Baumgart Reference

Baumgart has been cited as a Section 102(b) reference because it shows:

> "an underlayer (figure 10, item 57) formed of a substantially chemically-ordered alloy having a tetragonal crystalline structure, the alloy selected from the group consisting of alloys of AuCu, FePt, FePd, AgTi3, Pt Zn, PdZn, IrV, Copt and PdCd (column 8, lines 53-60 (these alloys are tetragonal));" and
>
> "an antiferromagnetic layer in contact with the underlayer (figure 10, item 59) and formed of a substantially-chemically-ordered alloy comprising X and Mn and having a tetragonal crystalline structure, wherein X is selected from the group consisting of Pt, Ni, Ir, Pd and Rh (column 8, line 53-60 (indicates FeMn can be used))"…

First, the Baumgart underlayer 57 referred to above is in actuality not layer 57, but an *optional seed layer* (not shown) between layers 57 and 59. Nevertheless, this seed layer of "NiFe or AuCu" in Baumgart is a *not* a chemically-ordered alloy having a tetragonal crystalline structure. It is well known that NiFe is disordered face centered cubic (fcc). This is also the case for the AuCu alloy referred to as an alternative to NiFe in Baumgart. While the structure of the AuCu seed layer is nowhere stated, Baumgart does state that "the underlayer must also have *high resistivity* to reduce electrical current shunting effects" (column 8, lines 42-43), so this would necessarily apply to the optional AuCu seed layer. However, it is well-known that for AuCu to have high resistivity it has to be disordered. More importantly, for Baumgart to meet the Section 102(b) anticipation requirement, it must expressly show or state that the AuCu seed layer is a *chemically-ordered alloy with a tetragonal crystalline structure* because this is the language in Applicants' claim 1. Because AuCu may be disordered *or* ordered and may be fcc *or* tetragonal, it is not possible to rely on the doctrine of inherency for the purpose of Section 102(b). Thus for the above reasons Baumgart fails to show this feature of the underlayer in Applicants' claim 1.

Second, Baumgart teaches that the optional seed layer of AuCu is necessary *only if* the antiferromagnetic layer is FeMn. Baumgart states that "when FeMn is utilized for the exchange bias layer, a seed layer, preferably of NiFe or AuCu, is desirable to ensure that the antiferromagnetic form of FeMn is obtained" (column 8, lines 57-60). However, FeMn is *not included* in Applicants' claims. Thus Baumgart does not teach the combination as claimed by Applicants. Baumgart teaches that *the AuCu underlayer is only applicable to a FeMn antiferromagnetic layer*, which is not included within the scope of Applicants' claims. Because

Baumgart does not teach or show an AuCu underlayer *in combination with* an antiferromagnetic layer of PtMn, NiMn, IrMn, PdMn or RhMn, as required by Applicants' claim 1, Baumgart is not an anticipating reference.

The Section 103(a) Rejection

Because the Section 103(a) rejection is based on either Kamijo or Baumgart as the primary reference, and neither of these references teaches that for which it is asserted, the Section 103(a) rejection fails to state a *prima facie* case of obviousness.

In view of the above comments Applicants believe all remaining claims are in condition for allowance. The Examiner is invited to call Applicants' attorney if a telephone conference will expedite the prosecution of this application.

Respectfully submitted,

May 8, 2006 **/ Thomas R. Berthold, Reg. No. 28,689 /**

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